



## PHENIX MuTr GAS OPS. IN THE PEH

procedure name

**PHENIX Procedure No. PP-2.5.2.12-09**

**Revision: D**

**Date: 1/25/2013**

### **Hand Processed Changes**

**HPC No.**

**Date**

**Page Nos.**

**Initials**

- *Typo: Under Section 2: There are two '1'. They should be 1. & 2.*
- *Suggestion: The numbering system under Section 5 could be improved by using 5.1.1, etc. instead of 5.A.1, etc.*
- *Typo: Section 6, it makes reference to Attachment 3. There is an attachment, but the title "Attachment 3" is missing*

### **Approvals**

 1/29/13  
PHENIX S E & I Date

 1/31/13  
Cognizant Scientist/Engineer Date  
/Activity Manager

 1-30-13  
PHENIX Safety Date

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### **Approvals**

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Cognizant Scientist/Engineer    Date  
/Activity Manager

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PHENIX Safety    Date

## REVISION CONTROL SHEET

LETTER	DESCRIPTION	DATE	UPDATED BY	APPROVED BY	CURRENT OVERSIGHT
A	First Issue.	3/1/2001	n/a	M. Sivertz, J. Muratu, W. Lenz, Y. Makdisi	n/a
B	No record of actual revisions	8/25/2003	n/a	n/a	Rob Pisani
C	Reviewed and found to require no procedural revisions. Attachment 1 Responsible persons changed from static list to web link for current expert list.	11/20/2009	D. Lynch	P. Giannotti, D. Lynch, R. Pisani	R. Pisani
D	Reviewed and found to be OK as is	1/25/2013	D. Lynch	P. Giannotti, D. Lynch, R. Pisani	P. Giannotti

## **1. Purpose**

There are four (4) modes of operation for the MuTr North and MuTr South gas systems. These are, VENT, RECIRCULATION, BYPASS, and SHUTDOWN modes. This procedure describes how to initialize, start, and run the Muon Tracking Gas System in these four modes.

All modes of operation are governed by the MuTr Gas Control Panel.

The Muon Tracker Gas Control Panel is designed to provide gas pressure monitoring and protection of the chambers from gas over/under pressure conditions. The panel receives pressure signals from transmitters in the PHENIX IR and allows manual, as well as, automatic shutdown of the MuTr gas supply valves and compressor.

### **CONTROL PANEL SWITCHES AND INDICATORS**

The MuTr gas control panel is divided into two sections. On the left side there is the MuTr north gas supply valve control switch, gas pressure digital indicators, high & low pressure alarm lights/reset switches, and north bypass and north vent mode indicator lights.

The right side is identical to the left except it is for the MuTr south system.

A vent mode key switch, compressor switch and north/south bypass key switch are installed along the control panel's vertical center line.

## **2. Responsibilities**

1. The system operator is responsible for conducting these procedures, logging activities, and responding to values that are out of range.
1. The operators listed in Attachment 2 are qualified to operate the MuTr gas system.

## **3. Prerequisites**

1. Operator shall have knowledge of the MuTr gas system indicated by being listed as an operator in Attachment 2 of this procedure.

## **4. Precautions**

1. The maximum inlet pressure for station two chambers are 2.5"WC. So the operator must keep the inlet pressure lower than 2.5"WC, and the outlet pressure around atmospheric pressure. The outlet pressure should not exceed 0.5" WC.

## 5. Procedure

### Key Parameters:

P<sub>tank</sub> : Pressure inside the tank . Controlled by CPR02. Indicated at CPG01 ~ 5 psig

P<sub>supply</sub>: Initial pressure of supply line at gas house. Controlled by MRR05.  
Indicated at MRG06 ~ 1.5"WC

F<sub>supply</sub>: Flow rate of the supply gas. Controlled by MRR05. Indicated at MRMFM01 ~ 6.0"WC

F<sub>return</sub>: Flow rate of the returned gas. Controlled by CPV02. Indicated at CPMFM > 3.0"WC

### 5.A Vent Mode Procedure and General Startup

If the MuTr North or South Gas Systems have been shutdown (gas valves closed), the return line pressures will be below the trip setpoint of 0.1" WC, and thus, the low pressure trips will be on. The solenoid operated gas valves cannot be re-opened under these conditions.

In order to re-start gas flowing, the vent mode of operation must first be selected via the front panel's key switch. **Caution must be observed to manually "line up" the MuTr North and South Return Line Valves to the EXHAUST position (in the gas mixing room) before selecting vent mode.**

Vent mode automatically bypasses the low pressure trips and allows the gas valves to be opened using the control panel switches. Once the gas valves are open, gas will begin to flow through the chambers and out the main vent. The regulated supply pressure (downstream of the pressure regulators) and return line pressure digital indicators will begin to read upscale. When the return line pressures rise above the low trip setpoint, the trips can be reset from the control panel.

Vent mode operation must always precede recirc mode operation.

### 5.A.1 Vent Mode Initialization

#### @ The Gas Mixing Rack

- 1.
1. Turn OFF electronic gas mixing unit, MKS 247D, in the computer room.
2. Close MRR01-05, MRFM01-03.
3. Close all valves
4. Open MRFMN and MRFMS
5. Open the following valves: MRBV01, 05, 06, 10 and MRCV04, 09, 12
6. Confirm that the supply line valves for AR, CO<sub>2</sub> and CF<sub>4</sub> are open and that MRG01-03 read=> 20 PSIG.
7. Fully open regulator valves and adjust MRR01, 02 to 15PSIG and MRR03 to 12PSIG. MRR03 is the regulator for CF<sub>4</sub>, the master gas for the electronic mixing system.
8. Set North and South 3-way return valves to the EXHAUST position for VENT MODE.

#### @ Compressor Panel :

1. Close all valves and regulators.
2. Open the valves CPV01, 02, 12, 13.

#### @ Distribution racks :      **NOTE: Perform only once.**

1. Close DPV101,201,301 and DPV001
2. Open all North and South flowmeters, supply and return.(DPFM1xx,2xx,3xx). Open DPV106, 206, 306, DPV002.
3. Open DPV103,203,303 if closed
4. Slowly open DPV101,201,301 and DPV001
5. Slowly open DPV001, Confirm DPG01 <3"wc
6. AGAIN, CONFIRM THAT DPFM101-104, 201-208, 301-308 AND DPV106,206,306 IS FULL OPEN
7. The supply flows should be nominally 300 cc/min. and the returns should be greater than zero.

#### @MuTr Gas Control Panel :

1. Turn VENT MODE switch to ON.
2. Compressor should be switched OFF – (light ON switch should be out)
3. Open supply line solenoid valves by pressing red “O” button switches.

**5.A.2 VENT MODE Gas Flow startup**@ Gas Mixing Rack :

1. Turn on MKS 247D unit in computer room.
2. Open MRAV01-03 valves.
3. MRG03 should read close to 12PSIG +/- 2PSIG.

@Compressor Panel :

1. Open CPR03 so dial reads 10 PSIG.
2. Fully open regulator valve so gas flows into the buffer tank. Wait for buffer to pressurize to 5 PSIG.

@ Back to Mixing Rack :

1. Open MRR05 – gas should start flowing thru the MRFMN and MRFMS flowmeters

**5.A.3 Running in VENT MODE**@Compressor and Mixing Rack panels :

1. Adjust CPR03 and MRR05 such that the buffer pressure stabilizes at 5PSIG and MRG06 reads 5-6" WC.
2. Then adjust MRFMN and MRFMS such that North and South flow 41pm and 51pm respectively all the while adjusting MRR05 such that MRG06 reads between 5-6" WC.
3. Under steady running conditions in vent MODE, MRMFM should read 7-81pm.

@Distribution Racks :

1. Confirm that DPG01 < 3" WC.
2. There should be no bubbler activity.
3. Adjust supply flowmeters within a given station such that all flows are ~300 cc/min.
4. One should observe some non-zero flow on all return flowmeters.

@Control Panel :

1. Low pressure readings will rise to > 0.19" WC at which point Low alarm switches can be reset.
2. The supply pressure readings should stay between 0.7 and 0.9" WC.

## 5.B RECIRCULATION MODE Procedure

Since the MuTr North and MuTr South Gas Systems are started in Vent Mode, they also operate together (in tandem) in Recirculation Mode.

In Recirculation Mode, the return line manual valve(s) are selected to COMPRESSOR, the gas supply solenoid valve(s) are OPEN, and the compressor is ON. The high and low pressure trips are active. If their setpoints are exceeded, they will cause automatic closure of the supply valves and shut down the compressor.

Additional interlocks are provided such that closing either supply valve or turning off the compressor during recirc mode will cause both systems to completely shut down (both valves closed and compressor off).

### NOTE :

**The MuTr North and South Gas Systems must be operating in vent mode before the compressor can be started. If gas flow has been off for more than 2 hours, AND/OR the lines have been opened to the atmosphere for maintenance work, then VENT MODE should be maintained for at least 12 hours before running in RECIRCULATION MODE.**

#### 5.B.1 Initial Conditions :

1. The MuTr North and South Gas Systems are operating in VENT MODE.

**Caution: The next step must always be performed before starting the compressor.**

#### 5.B.2 Switching to and Running in Recirc. Mode.

##### @ Control Panel :

1. In the gas mixing room, line up the MuTr north and south return line valves to the "COMPRESSOR" position.
2. Turn the compressor switch to ON.

**Note: The PCR alarm "MuTr Gas Controller Trouble" will now be in alarm, momentarily, until the vent mode switch is turned off.**

3. Turn the vent mode key switch to OFF.

##### @ Compressor Panel :



1. SLOWLY open CPV04, the compressor throttle, until CPMFM reads 1-21pm flow.
2. After 5 minutes, fully open CPV04.
3. Adjust CPR03 such that buffer pressure settles at 6 PSIG.

@ Mixing Rack :

1. While adjusting CPR03, continue adjusting MRR05 such that MRG06 stays within the range 5-6" WC.
2. The operator must continue to monitor the buffer pressure and MRG06 for 2 hours to make sure system settles into a stable RECIRCULATION MODE – no compressor cycling.
3. In steady Recirc. Mode, the recirculation fraction will be 50-60%.

**Note: The PCR alarm “MuTr Gas Controller Trouble” will clear. Gas is now flowing from the supply valves, through the chambers and into the compressor. Recirculation mode will be maintained provided there are no high/low pressure trips, compressor is not turned off or the solenoid valves are not manually closed.**

## 5.C MuTr North (South) Bypassed / MuTr South (North) Vent Mode Procedure

### Bypass Mode Description

The bypass mode allows singular operation of either the north or south MuTr gas system. This is performed using the control panel's bypass key switch. If the MuTr North System is in NORTH BYPASS, the north gas supply valve is interlocked closed and cannot be opened from the control panel. Likewise, if the MuTr South System is in SOUTH BYPASS, the south gas supply valve is interlocked closed and cannot be opened.

Vent mode or recirculation mode operation and protective trip action is identical to when they are operated simultaneously.

**Note :** This section applies to either the MuTr North or MuTr South bypass operation depending on the position of the bypass switch on the control panel.

### 5.C.1 BYPASS VENT MODE Initialization:

@Mixing Rack and Compressor Panel : (Same as in Subsection 5.A.1)

**Run the MuTr South (North) System in Vent Mode with the MuTr North (South) System in Bypass.**

@MuTr Gas Control Panel :

1. Turn the bypass key switch to NORTH (South). Note: The North (South) BYPASSED light will turn on. The MuTr North (South) Gas Solenoid Supply Valve is interlocked off. It's not possible to open the valve. The MuTr North (South) low pressure trip light will remain ON. While in North (South) Bypass, the North (South) low trip is disabled from causing a closure of the MuTr South (North) Gas Supply valve or tripping off the compressor.

**Caution: The next step must always be performed before turning the vent mode key switch on.**

2. In the Gas Mixing Room, line up the MuTr South (North) return line valve to the EXHAUST position.
3. Turn the vent mode key switch to ON. Note: Only the South (North) yellow vent mode light will flash on and off.
4. OPEN the MuTr South (North) solenoid supply line valve from the control panel by pressing the red "O" button switch.

### 5.C.2 BYPASS VENT MODE Startup

@Mixing Rack : Same as for 5.A.2

@Compressor Panel : Same as for 5.A.2

@Back to Mixing Rack :

1. Open MRR05 – gas should start flowing through either the MRFMN (South Bypassed) or MRFMS (North Bypassed) flowmeter.

### 5.C.3 Running in BYPASS VENT MODE

@Compressor and Mixing Rack Panels :

1. Adjust CPR03 and MRR05 such that the buffer pressure stabilizes at 5 PSIG and MRG06 reads 5-6" WC.
2. Then adjust MRFMN (for South BYPASSED) or MRFMS (for North BYPASSED) such that the flow is 51 pm all the while adjusting MRR05 such that MRG06 reads between 5-6 WC.
3. Under steady running conditions in BYPASS VENT MODE, MRMFM SHOULD READ 4-51PM.

@Control Panel :

1. Push the MuTr South (North) Low pressure trip light pushbutton to RESET (clear) the trip. This action will clear the PCR Alarm: "MuTr Gas Controller Trouble". The existing MuTr North (South) Low Pressure Trip will not cause the PCR Alarm when in North (South) Bypass. **Note: Vent mode operation for MuTr South (North) can continue until it's desired to operate it in recirculation mode.**

The gas supply high pressure trip setpoint is 1.5 inches W.C. If this level is exceeded, the system will shut off and activate the PCR alarm.

## **5.D MuTr North (South) Bypassed / MuTr South (North) Recirculation Mode Procedure**

**Note :** The MuTr South (North) Gas System must be operating in vent mode before the compressor is started.

### **5.D.1 Initial Conditions**

All conditions in accordance with Section 5.C (MuTr South (North) Vent Mode) are true.

### **5.D.2 Switching to and running the MuTr South (North) System in Recirculation Mode**

**Caution:** The next step must always be performed before starting the compressor.

#### **@Mixing Rack:**

1. In the Gas Mixing Room, line up the MuTr South (North) Return Line Valve to the COMPRESSOR Position.

#### **@Control Panel:**

1. Turn the Compressor Switch to ON. Note: The PCR Alarm “MuTr Gas Controller Trouble” will now be in alarm, momentarily, until the vent mode switch is turned off.
2. Turn the vent mode key switch to OFF.

#### **@Compressor Panel :**

1. SLOWLY open CPV04, the compressor throttle, until CPMFM reads 1-21pm flow.
2. After an additional 5 minutes, fully open CPV04.
3. Adjust CPR03 such that buffer pressure settles at 6PSIG.

#### **@Mixing Rack :**

1. While adjusting CPR03 continue adjusting MRR05 such that MRG06 stays within the range 5-6” WC.
2. The operator must continue to monitor the buffer pressure and MRG06 for 2 hrs. to make sure system settles into a stable RECIRCULATION MODE – no compressor cycling.
3. In steady Recirc. Mode therecirculation fraction will be 50-60%.

**Note:** The PCR alarm “MuTr Gas Controller Trouble” will clear. Gas is now flowing from the South (North) Supply Valves, through the chambers and into the compressor. Recirculation mode will be maintained provided there are no MuTr South (North) High/Low Pressure Trips, the compressor is not turned off, or the South (North) Gas Supply Valve is not operated closed.

## **5.E Gas Flow STOP MODE**

### **@Control Panel :**

1. Turn Compressor switch to OFF – light should be out.
2. Turn VENT MODE key switch to ON.
3. Push black “-“ buttons on North and South solenoid valve switches

### **@Mixing Rack :**

1. Set North and South 3-way return valves to the EXHAUST position.
2. Close MRR05 regulator
3. Turn off MKS-247 gas mixing unit in the computer room.

### **@Compressor Panel :** Close CPV04

2.

## **6. Documentation**

All notes and observations should be recorded in the MuTr gas system logbook. A gas system log sheet (attachment 3) should be completed every 8 hours and placed in the log sheet binder while gas is flowing.

## **7. References**

1. MuTr Gas System Home Page <http://spin.riken.bnl.gov/~jiro/mutrgas.html>

## **8. Attachments**

1. MuTr Gas System Drawings
  - A. Main Rack
  - B. Compressor Panel
  - C. Distribution Panel
2. Responsible People/Operators

## 3. Gas system log sheet

**9. Gas Control Component Table**

## Main Rack (MRA,B,C,Dxx)

Panel A: MRAV01-03	Valve
MRR01-03	Regulator ~ 15 psig
MRFC01-03	Mass Flow Controller ~ 1 slpm
MRFM01-03	Manual Flow meter ~ 1 slpm
MRG01-03	Pressure Gauge ~ 20 psig
Panel B: MRBV01-12	Valve
MRR04-05	Regulator ~ 2 psig
MRG04	Pressure Gauge ~ 15 psig
MRMFM01	Mass Flow Meter ~ 2 slpm

Note: MRMFM is a passive electronic flowmeter that measures the total gas flow being sent to the North and South supply lines via their respective flowmeters.

Panel C: MRCV01-11	Valve
MRG05-06	Pressure Gauge ~ 10 psig and 2"WC
Panel D: MRDV01-08	Valve
MRG07	Pressure Gauge ~ 0 "WC

## Compressor Panel (CPxx)

CPV01-15	Valve
CPG01-02	Pressure Gauge ~ 10 psi and 15psi
CPMFM	Mass Flow Meter ~ 1slpm

Note: CPMFM is a passive electronic flowmeter that measures the total gas flow from the North and South return lines going into the compressor.

Compressor  
TANK

## Distribution Panel (DPxx)

Station 1	DPV101-106	Valve
	DPFM101-104	Flow meter (Return)
	DPFM111-114	Flow meter (Supply)
	DPMFM01	Mass Flow Meter
	DPB001	Bubbler ( < 2.5 "wc)
Station 2	DPV201-206	Valve
	DPFM201-208	Flow meter (Return)
	DPFM211-218	Flow meter (Supply)
	DPMFM02	Mass Flow Meter
	DPB002	Bubbler ( < 2.5 "wc)
Station 3	DPV301-306	Valve
	DPFM301-308	Flow meter (Return)
	DPFM311-318	Flow meter (Supply)
	DPMFM03	Mass Flow Meter
	DPB003	Bubbler ( < 2.5 "wc)

Common	DPV001-002	Valve
	DPMFM4-5	Mass Flow Meter
	DPB004-005	Bubbler ( < 2.5 “wc)

## 10. Electric Component Table

### Main Rack

Mass Flow Controller	MKS #1179A12CS1BV 15pin Type D control cable (MKS #CB259-5-xx)
Mass Flow Meter	Matheson #8112-0414,0424 12VDC (Circle Jack)
Pressure Transmitter	Dwyer #7117-6060 2-wire readout cable
H2O Analyzer	KAHN # 100VAC (2-wire) power 2-wire readout cable
O2 Analyzer	Teledyne #3010TA-F-K 110VAC power (3-wire) 4-wire signal cable

### Compressor Panel

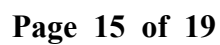
Compressor	KNF #UN026STI EX 110VAC wire
Mass Flow Meter	Matheson #8112-0414 12VDC (Circle Jack)

### Distribution Panel

Mass Flow Meter	Matheson #8112-0414 12VDC (Circle Jack)
Differential Pressure Transmitter	Dwyer #3020SGT DC Power 12.3-35VDC (2-wire connection)

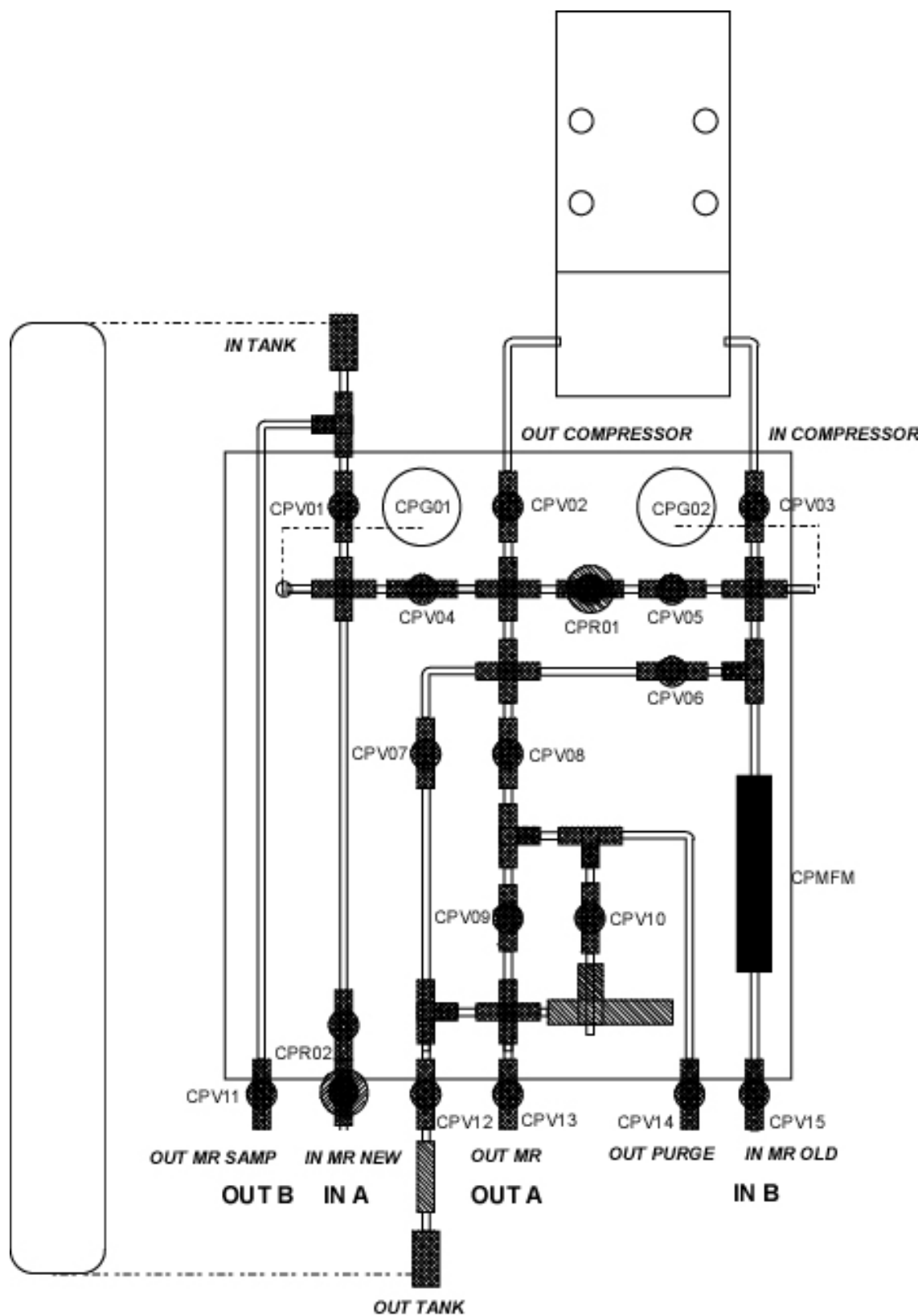
### Computer Rack

Mass Flow Readout	MKS #247D 115VAC power (plug type)
H2O Analyzer Readout	100VAC power (plug or 2-wire)
O2 Analyzer Readout	100VAC (plug)

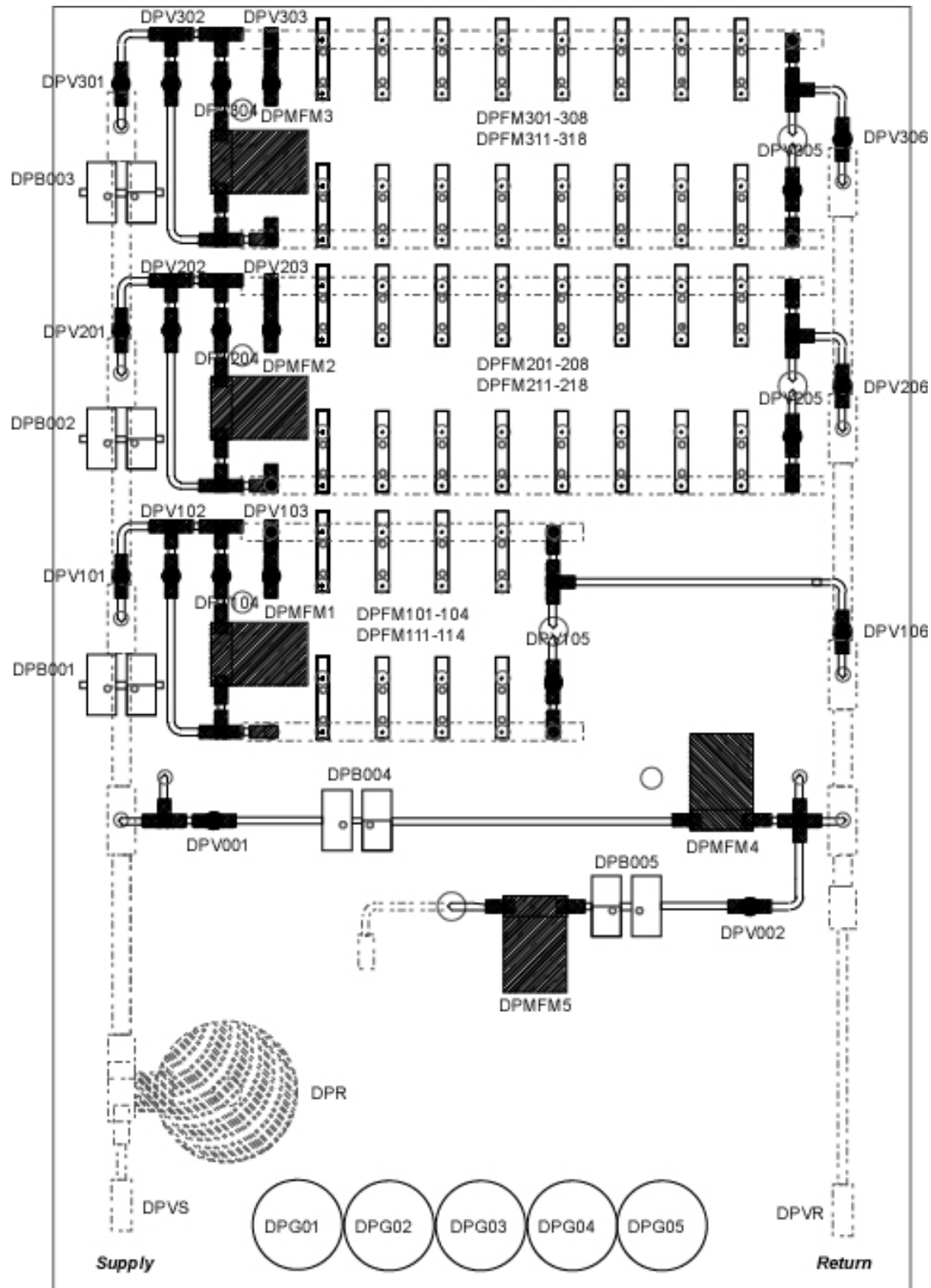




## Attachment 1-B: Compressor Panel



## Attachment 1-C: Distribution Panel



Attachment 2: Responsible People/Operators

**Contact Information**

Contact Information for experts for this subsystem can be found on the PHENIX Internal Website in the [RUN] link at: (NOTE: replace ## by the current run number)

**[https://www.phenix.bnl.gov/WWW/run/##/contacts/subsys\\_experts.html](https://www.phenix.bnl.gov/WWW/run/##/contacts/subsys_experts.html)**

General PHENIX contact info can similarly be found at:

**<https://www.phenix.bnl.gov/WWW/run/##/contacts/>**

Gas system experts can be found at:

**[http://phenix.bnl.gov/WWW/tracking/gas\\_system/people.html](http://phenix.bnl.gov/WWW/tracking/gas_system/people.html)**

In addition, the Run Coordinator and Shift leader for the current run shall have a paper copy available of the contact information for the appropriate systems experts for this and all other PHENIX subsystems.

**MuTr-Gas-CHECKLIST-V1.0****PHENIX MuTr GAS SYSTEM CHECK LIST (Without Slow Control)**

(To be filled out once per shift and placed in Gas System Binder)

**Main Rack and Compressor Panel in the Mixing House**

Sensor	Check Point	Nominal	Minimum	Maximum	Value	Comments
MRR01	Ar Regulator Pressure	20 psig	17 psig	30 psig		
MRR02	CO2 Regulator Pressure	20 psig	17 psig	30 psig		
MRR03	CF4 Regulator Pressure	15 psig	10 psig	20 psig		
MRG04	Mixed New Gas Pressure	15 psig	5 psig	20 psig		
MRG05	Tank Output Pressure	5 psig	1 psig	10 psig		
MRG06	Supply Pressure	3" WC	1" WC	5" WC		
MRG07	Return Pressure	0.1 " WC	-0.5" WC	0.5" WC		
MRMFM	Supply Flow	6 LPM	2 LPM	10 LPM		
CPMFM	Return Flow	3 LPM	0.5 LPM	10 LPM		
Compressor	Compressor Power ON/OFF	ON	--	--		

**Mass Flow Controller in the Mixing House**

Sensor	Check Point	Nominal	Minimum	Maximum	Value	Comments
LED Indicator	Power ON/OFF	ON	--	--		
Channel 1	CF4 Flow Rate	1.2 LPM	0.1 LPM	3.0 LPM		
Channel 2	CO2 Flow Rate	1.8 LPM	0.15 LPM	4.5 LPM		
Channel 3	Ar Flow Rate	3.0 LPM	0.25 LPM	7.5 LPM		

If any of the above **CHECK** are outside their normal range, immediately contact a MuTr gas expert.

Operator \_\_\_\_\_ Date & Time \_\_\_\_\_

Gas Expert:

Hideyuki Kobayashi

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